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Population fluctuation of the predacious insects of the pear psylla (*Cacopsylla pyri* L.) in Attica (Greece)

Abstract - In a pesticide free pear-orchard, in Koropi, Attica (Greece) during the year 1994-1996 it was found a satisfactory number of predacious insects belonging to the families Chrysopidae and Anthocoridae; the most representatives were *Chrysoperla carnea* Steph. and *Anthocoris nemoralis* F. The role of *C. carnea* and *A. nemoralis* is proven and justifiably so, both are considered to be the most active in the control of pear psylla populations (*Cacopsylla pyri* L.). Additionally in the same pear orchard were found many predacious Coccinellidae while their activity does not appear to play an important role in the control of the psylla population since their presence in the field is rather incidental. In the field *C. carnea* appears first in February or March and *A. nemoralis* follows in March. The population of these insects increases gradually following the population increases of their host. The highest density is observed from the end of April till the end of July. Reduction of their population follows during the summer months to reach again satisfactory levels in the end of September. Especially *A. nemoralis* will survive in nature until the end of November and its population will disappear contemporary with the psylla population.

Riassunto - *Fluttuazione delle popolazioni di insetti predatori di psilla del pero (*Cacopsylla pyri *L.) in Attica (Grecia).*

In un pereto non trattato, a Koropi Attica (Grecia), durante gli anni 1994-1996, è stata trovata una soddisfacente popolazione d'insetti predatori, delle famiglie Chrysopidae e Anthocoridae; i principali rappresentati sono rispettivamente *Chrysoperla carnea* Steph. e *Anthocoris nemoralis* F.. Il loro ruolo é già noto, dato che si considerano specie molto attive, capaci di partecipare al controllo naturale di psilla del pero (*Cacopsylla pyri* L.). Nello stesso pereto, inoltre, è stato trovato un gran numero di predatori appartenenti alla famiglia Coccinellidae; la capacità predatrice non sembra molto interessante, dato che la loro attività viene considerata occasionale. La presenza in natura di *C. carnea* inizia nel periodo di febbraio-marzo, mentre quella di *A. nemoralis* alla fine di marzo. L'aumento della popolazione di questi insetti è in funzione dell'incremento delle popolazioni dell'ospite e segue lo sviluppo tanto di *C. carnea*, che di *A. nemoralis.* Durante il periodo fine marzo - fine luglio, le popolazioni di questi insetti si trovano a notevoli livelli, che però si abbassano nel periodo estivo, risalendo di nuovo alla

fine di settembre e arrivando così a valori soddisfacenti. Specialmente *A. nemoralis,* puo restare in natura con notevoli popolazioni fino alla fine dell'autunno, per scomparire insieme all'ospite alla caduta delle foglie.

Key words: *Chrysoperla carnea, Anthocoris nemoralis*, pear psylla, *Cacopsylla pyri.*

INTRODUCTION

One of the most serious pests of pear tree is *Cacopsylla pyri* (L.), better known as "psylla of pear tree". This problem appears to be the result of the continuous and excessive use of various insecticides with the development of resistance to various insecticides as well as the diminishing of its natural enemies (Harries & Burts, 1965; Delorme, 1985; Staubli & Antoni, 1985; Hassan *et al.*, 1987).

In Greece, *C. pyri* completes 5-6 generations each year. Usually the attack is more severe in the spring and fall and low in the winter (Broumas *et al.*, 1989; Souliotis & Broumas, 1990).

The importance of the predators as a limiting factor of *C. pyri* has been reported by many workers; (Solomon *et al.*, 1989; Scutareanu *et al.,* 1994). The most important natural enemies are *Anthocoris nemoralis* L. (Heteroptera: Anthocoridae) and *Chrysoperla carnea* (Neuroptera: Chrysopidae) (Solomon *et al.*, 1989; Scutareanu *et al.*, 1994). Particularly *A. nemoralis* is considered to be the primary antagonistic factor of *C. pyri* in many countries. The presence of many species of the family Coccinellidae meanwhile their role it does not appear to have a clear relationship with the pear psylla (Pericart, 1972; Atzer, 1977, 1979; Rield, 1981; Fauvel *et al.*, 1981; Nguyen *et al.*, 1984; Rieux & Faivre D'Arcier, 1984; Rieux *et al.*, 1994). The relative importance of the various predacious species is very likely to differ from one region to an other since the climatic conditions and the presence of various hosts in different seasons of the year is probable to be different in every region.

For these reasons it has been decided to deepen our knowledge on the predators of *C. pyri* as well as to study the fluctuation of their population during the year in relation to the fluctuation of their host population. This information is useful for the application of Integrated Pest Management programmes.

MATERIALS AND METHODS

Trials were carried out in a pear-orchard, where pesticides had not been applied, in the Koropi, Attica area on a total of 170 trees of the variety "Krystalli". For the recording of the predacious species and the *C. pyri* every week samples were taken with the method of Burts & Brunner (1981) from ten trees and four branches per tree. Every year the sampling started at the beginning of February and finishing at the end of November. This method consists of the shaking of branches (frappage) above a

cloth receiver 50x50 cm after a double, abrupt hit with a stick wrapped with styrofoam; that way collecting the adults of *C. pyri*, and the predacious adults. The shaking of branches took place only in the morning since the insects are less active during that time of the day. This study took place during the years 1994-1996.

RESULTS AND DISCUSSION

Table 1 gives the total adult number of predacious species collected in every period of sampling during 1994-1996. These results indicate that in the pear trees 18 species of predacious insects were counted; 7 belong to Neuroptera (6 in the family Chrysopidae and 1 in the family Raphidiidae), 9 to Coleoptera (Coccinellidae) and 2 to Heteroptera (Anthocoridae). *A. nemoralis* was found the most common Anthocoridae. Its population percentage in the total number of insects collected was found to be 54.62% in 1994, 52.18% in 1995 and 47.12% in 1996. Moreover, *A. nemoralis* was found in high population in other growing pear areas of Greece (Larissa & Magnesia) and on wild pear-trees in Reginion area in Central Greece (Santas, 1987;

Table 1 - Predacious insects collected in Koropi during the years 1994-1996.

Species	1994		1995		1996	
	No. insects	% of the total number of insects	No. insects	% of the total number of insects	No. insects	% of the total number of insects
Chrysopidae:						
Chrysoperla carnea Steph.	124	22.50	212	23.14	182	26.92
Anisochrysa prasina Burm.	28	5.08	32	3.50	13	1.92
Anisochrysa zelleri Schneider	17	3.08	14	1.52	9	1.33
Anisochrysa flavifrous Brauer.			10	1.09	6	0.86
Chrysopa septempunctata Wasm.	5	0.90	8	0.87		
Italochrysa italica Rossi					2	0.30
Rhaphidiidae:						
Rhaphidia sp.			44	4.08		
Coccinellidae:						
Scymnus (Pullus) suturalis Thbg	48	8.77	78	8.55	26	3.85
Scymnus (Pullus) subvillosus Goeze	11	1.99	12	1.32		
Coccinella septempunctata L.	6	1.08	9	1.98	17	2.51
Propylaea quatordecimpunctata L.	5	0.90	7	0.76	32	4.73
Adalia bipunctata L.					39	5.78
Stethorus punctillum Weise					3	0.44
Rhodolia cardinalis Muls.					1	0.15
Sympharmonia conglobata L.					2	0.30
Exochomus quadripustulatus L.					1	0.15
Anthocoridae						
Anthocoris nemoralis F.	301	54.62	478	52.18	319	47.19
Orius sp.	6	1.08	12	1.32	24	3.55
TOTAL	551	100	916	100	676	100

Broumas *et al.*, 1989; Souliotis & Broumas, 1990; Kapatos & Stratopoulou, 1995). These results are in accordance with the data of other workers in different countries, especially in Mediterranean region, indicating that *A. nemoralis* is the most important species to control *C. pyri* (Broumas *et al.*, 1984; Nguyen *et al.*, 1984; Souliotis & Broumas, 1990; Girbic *et al.*, 1990; Kapatos & Stratopoulou, 1995). *Orius* sp. appears that is not a main limiting factor of *C. pyri* since was found at very low levels in the experimental orchard. In contrast, it was observed in great numbers on wild pear trees in Reginion area (Santas, 1987) as well as in other Mediterranean countries where is registered as an important factor among the predacious population of the Anthocoridae (Harries & Burt, 1965; Burt & Brunner, 1981; Matias, 1990).

Among Neuroptera, *Chrysoperla carnea* Steph. is an important percentage of the total number of predacious species registered (22.50%, 23.14% and 26.92% for 1994, 1995 and 1996 correspondingly) and it is only second in population density after *A. nemoralis.* In addition to Attica area, *C. carnea* was found in high populations in various pear orchards in Greece (Santas, 1987; Broumas *et al.*, 1989; Souliotis & Broumas, 1990). Its importance was mentioned in other Mediterranean countries, as France, Portugal and Yugoslavia (Bouyjou *et al.*, 1984; Nguyen *et al.*, 1984; Girbic *et al.*, 1990; Matias, 1990), since it is regarded as polyphagous insect and its predatory activity on *C. pyri* has been reported (Santas, 1987). It is possible that their presence in pear orchards may not be related to their predatory activity. It could also be that producing honeydew by *C. pyri* play a part, since honeydews considered as a basic sourse of food for *C. carnea*, especially during the period of intense infestation of pear trees from psylla (Bouyjou *et al.*, 1984). The other Neuroptera appeared to play a rather insignificant role in the population reduction of *C. pyri* since they were found at very low levels. It is also possible that their presence in certain pear trees it was not to be related with *C. pyri.*

All Coccinellidae were found at very low percentages with the exception of *Scymnus sutularis* Thbg. in 1994 and 1995 (8.77% and 8.55% correspondingly). It should be also mentioned the very low percentage of the species *Adalia bipunctata* L., *Propylaea* 14-*punctata* L. and the complete absence of a polyphagous effective natural enemy of *C. pyri, Stethorus punctillum* Weise, which can be found in abundance in pear-orchards in Portugal (Matias, 1990). These results indicate that the Coccinellidae do not play an important role in the control of the population of *C. pyri.*

Figure 1 indicates the population fluctuation of *A. nemoralis* and *C. carnea* as well as of the adults of *C. pyri. A. nemoralis* showed approximately the same fluctuations during the three years which was similar to that of *C. pyri* with only difference that every year the period of April-July the increased population of phytophagous noticed fifteen days earlier than the predatory population. *A. nemoralis* appeared in the pear orchard at the end of March-beginning of April, but significant populations of the insect were not observed before May. The population maximum in 1994 and 1995 was registered at the end of May-beginning of June and in 1996 at the end of June-beginning of July. The important increase of *A. nemoralis* in June is obviously due to the favorable conditions for the development since the population

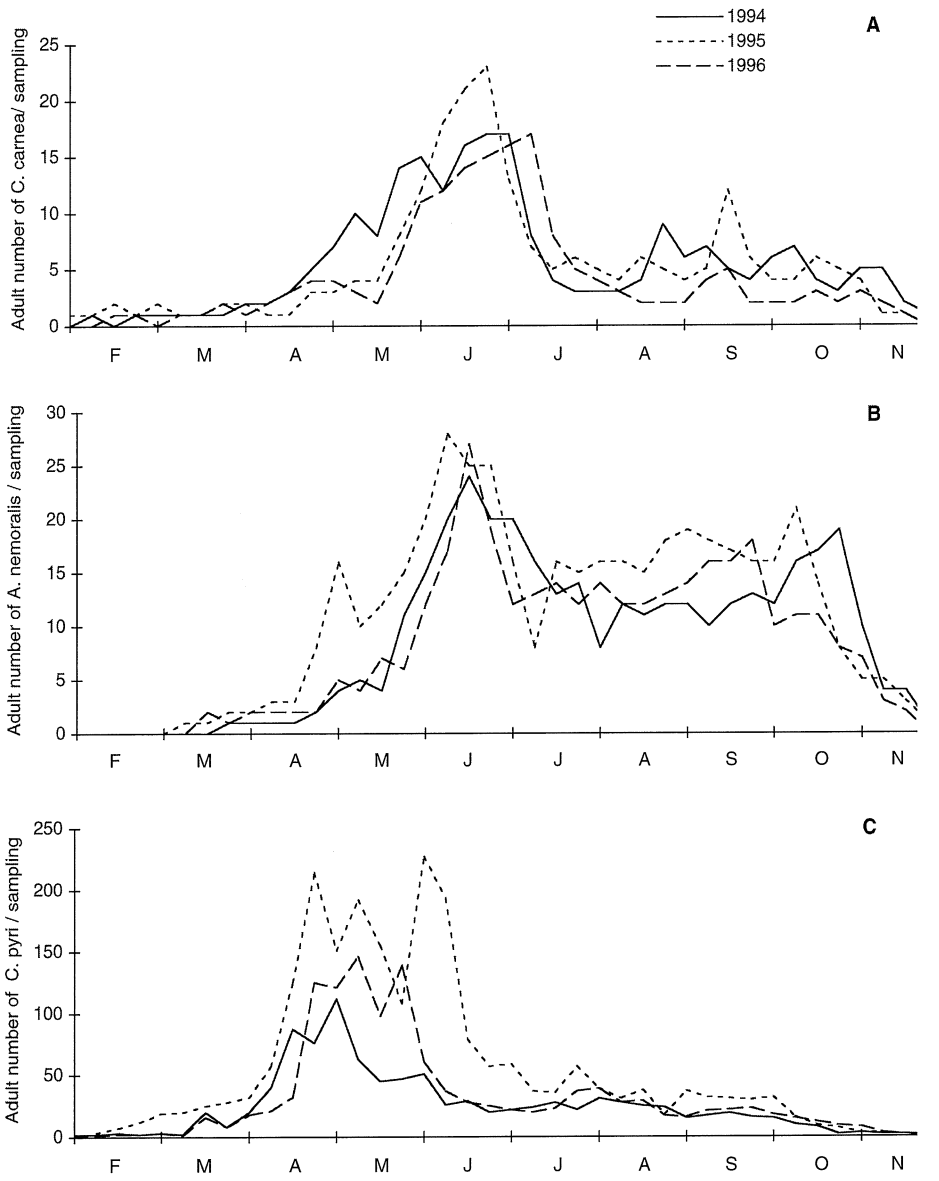

Fig.1 - Evolution of *C. carnea* adult population density (A), *A. nemoralis* (B), as well as of the adults of C. *pyri* (C) in the Koropi, during the years 1994-1996.

increase of *C. pyri* preceded to *A.nemoralis*, providing for its increased food needs. It is known that each of the adults of this predatory can prey almost 300 larvae of *C.pyri* (Nguyen *et al.*, 1984). Later on (beginning of July) the population of *A. nemoralis* was decreased significantly; this finally is due to high summer temperatures while for the rest of the period the population of this insect was maintained in relatively lower levels with small fluctuations just as the population of *C. pyri.*

The fluctuation of *A. nemoralis* has common points with the dynamic of this insect in the South-West France (Bouyjou *et al.*, 1984). However in other countries such as South-East France, Spain, Holland and Central Greece (Magnesia) (Rieux *et al.,* 1994; Sarasua *et al.*, 1994; Scutareanu *et al.*, 1994; Kapatos & Stratopoulou, 1995) intense fluctuations of *A. nemoralis* during the whole period (May-October) have been reported, which followed the corresponding fluctuations of phytophagous hosts. It is obvious that the dynamic of *C. pyri* in every case is determining the population fluctuation of *A. nemoralis.*

C. carnea showed the same evolution of *A. nemoralis;* in the warm and dry Attica area appeared approximately in the middle of February, almost a month earlier than *A. nemoralis*. The population increased gradually from the end of April, reaching its maximum at the end of June-beginning of July. In the growing pear areas in Central Greece, *C. carnea* population seems to exist over the whole summer period in high numbers (Souliotis & Broumas, 1990). Similar observations have been made in Portugal (Matias, 1990), while in South France its population fluctuated with small variations and survived in nature until the end of October, following the corresponding fluctuations of *C. pyri* and *A. nemoralis.*

CONCLUSIONS

The results showed that in the Koropi (Attica area) primarily *A. nemoralis* and secondary *C. carnea* are the most important predacious species for controlling *C. pyri.* The activity of *A. nemoralis* is considered very important for the biological control of the psylla population in almost all countries where pears are grown (Bouyjou *et al.*, 1984; Nguyen *et al.*, 1984; Rieux & Faivre d' Arcier, 1984). The fluctuation of this insect population is determined to a great extented by the dynamic of *C. pyri.* High density of *A. nemoralis* appears in the pear relatively late (June) and is in rather low levels during the period of the intense infestation of pear trees from psylla (May). This could be due for two reasons: 1) the host population during the previous infestation period (February-March) is low and cannot support the growth of high populations of *A. nemoralis*; 2) it is probable that *A. nemoralis* prefers to attack other hosts in May.

The fact that the maximum of the activity of *A. nemoralis* occurs during the period where psylla infestation is very high is a good prospective for the integrated control of this insect.

However, for the complete development of *A. nemoralis* on the one hand has to be investigated the possibility of movement of the native population and on the other hand have to be studied the reasons of the low presence of this predators in May, a period that psylla population increased rapidly.

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